AN1695
APPLICATION NOTE

TSM108 EVALUATION BOARD
12V to 6V DC/DC CONVERTER

by Anthony BOIMOND

1 - Introduction

The TSM108 is a step down controller that features constant voltage and constant current regulation. It can drive either a P-channel Mosfet or a PNP bipolar transistor. The principle of operation of the TSM108 is widely described in the application note attached to the datasheet. The goal of this document is to describe the TSM108 Evaluation Board.

The Evaluation Board was designed to allow different converter configurations. Several options for power semiconductor footprints are available on the PCB in order to make it adaptable to a wide range of converter output power. In a first step, this application note will describe the typical application. Then the various options available on the Evaluation Board PCB will be explained.

2 - TSM108 typical application

2.1 Description

The TSM108 is especially suited for cigarette lighter accessories. The typical application described in this note is a battery charger with the following characteristics:

Input voltage: Vin = 12V

Output voltage: Vout = 6V

Maximum output current: Iout = 800mA

A picture of the Evaluation Board in the typical application configuration is shown on Figure 1. The related schematic is described on Figure 2.

Figure 1 : TSM108 Evaluation Board

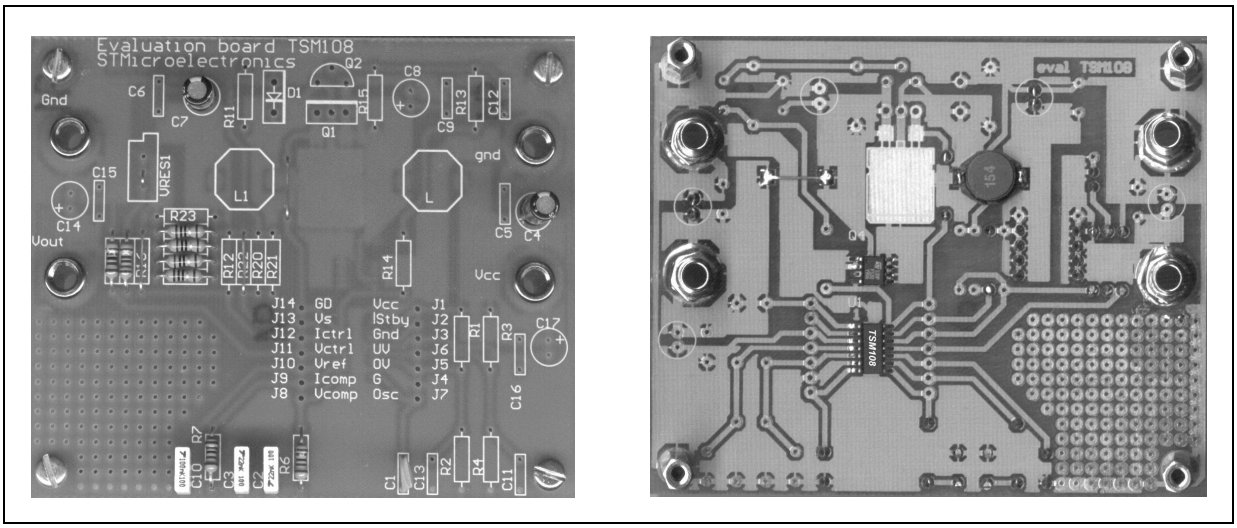
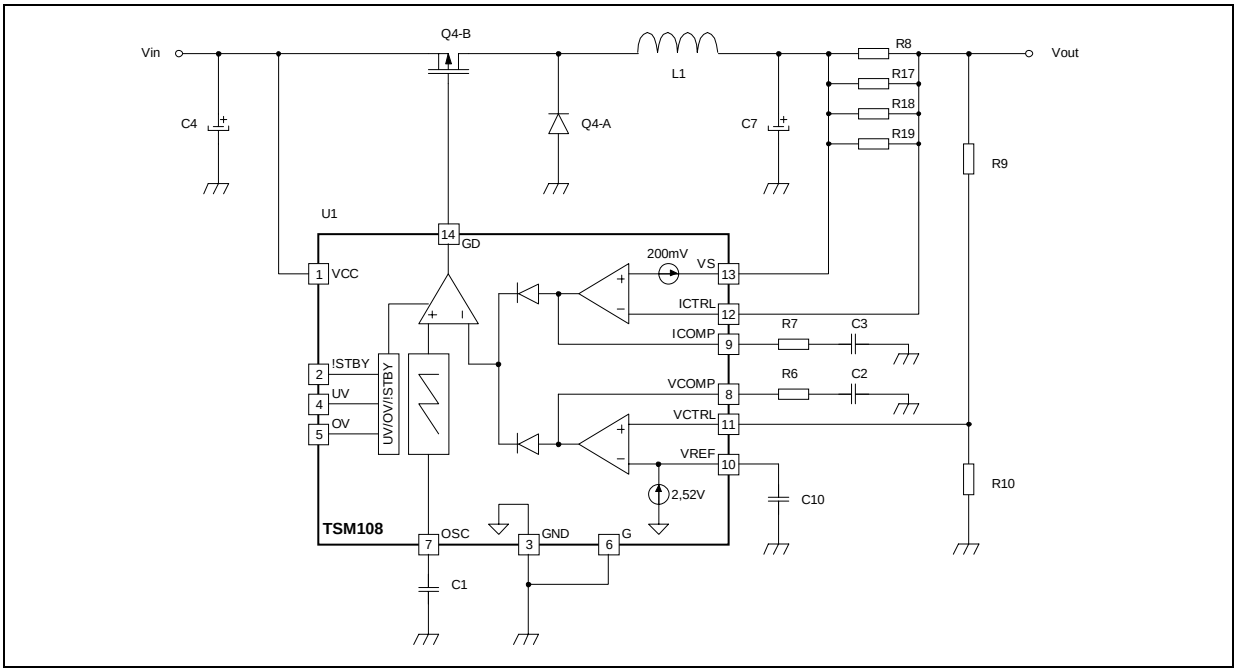


Figure 2 : Typical application schematic



The list of components used in the typical application board is shown in the bill of material here below. All other components are not mounted. Passive components like capacitors and resistors used in this Evaluation Board are through-hole components to be more easily changed by the user. Of course, in real-life application, surface-mounted devices will be used and the whole application can fit into a very small PCB area.

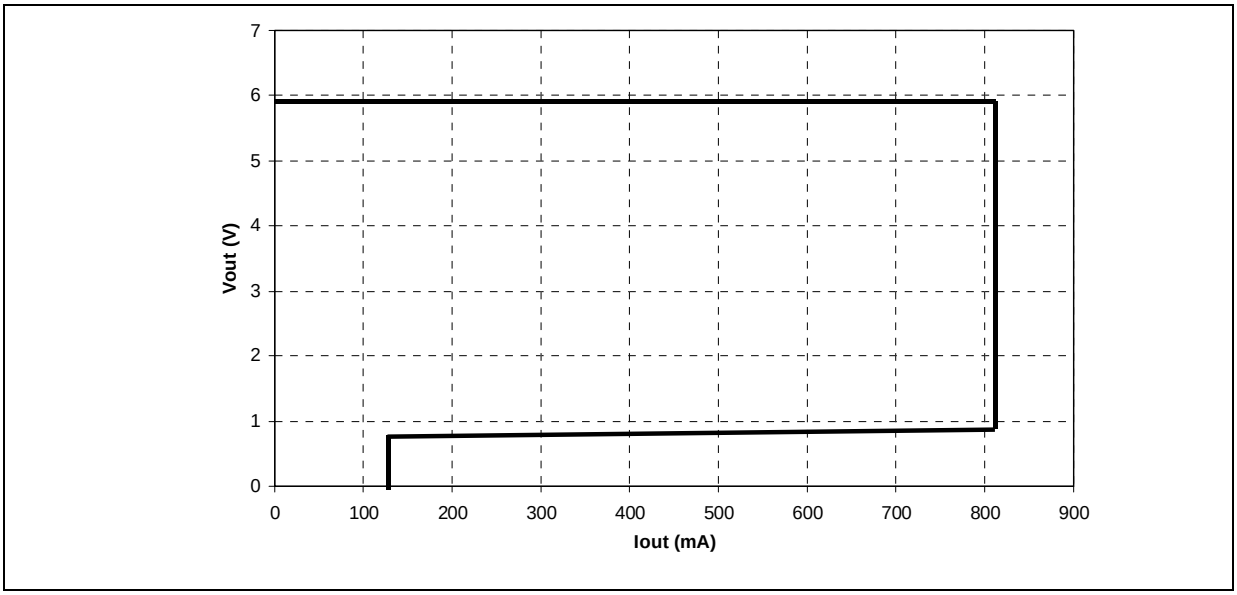
Table 3 : Bill of material

Reference	Value	Description	Manufacturer
U1	TSM108ID	PWM controller	STMicroelectronics
Q4	STS3DPFS30	Mosfet + diode	STMicroelectronics
L1	P0250.154T	150µH - buck main inductor	Pulse
L	short circuit	filtering inductor	
C1	220pF	oscillator capacitor	
C2-C3	22nF	compensation capacitors	
C4-C7	47µF-25V	buck input and output capacitors	Rubycon ZL
C10	100nF	voltage reference bias capacitor	
R8-R17-R18-R19	1Ω	shunt resistor	
R6-R7	22kΩ-10%	compensation resistors	
R9	15kΩ-1%	divider bridge upper resistor	
R10	11kΩ-1%	divider bridge lower resistor	
R16-R22	short circuit		

2.2 Performances

As explained in the datasheet, the step-down converter using TSM108 can feature an accurate constant-voltage and constant-current regulation. The V/I output characteristics of the DC/DC converter is shown in Figure 4. Input voltage was set at 12V during this test. As explained in introduction, voltage regulation is set to 6V and current regulation is set to 800mA. At output voltage lower than 1V, the foldback can be observed in the current regulation.

Figure 4 : Output voltage versus output current characteristics

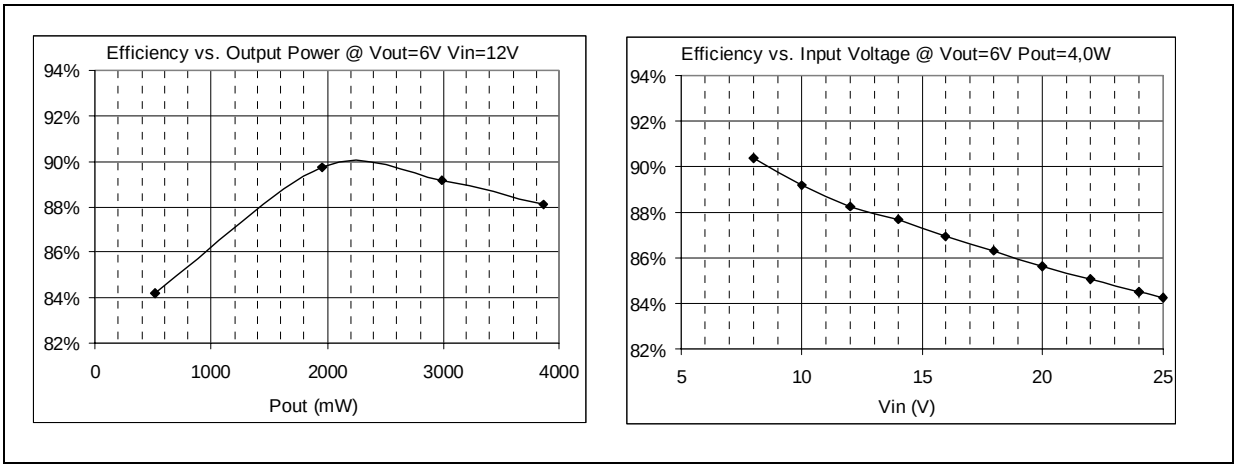


The efficiency of the DC/DC converter was measured in different conditions, as shown in Figure 5.

On the left chart, the influence of output power (Pout) over efficiency is studied. It should be noted that during this test, the converter was operating in constant-voltage mode, therefore with Vout=6V and Iout<800mA. Input voltage Vin was equal to 12V during the test. The efficiency appears to be always between 84% and 90%.

On the right chart, the influence of input voltage (Vin) over efficiency is studied. The converter was operating in constant-voltage mode and the output power was constant equal to 4W during the test. With the input voltage varying from 7V up to 25V, the converter efficiency appears to be between 84% and 90%.

Figure 5 : Efficiency of the DC/DC converter versus output power and input voltage



3 - Evaluation board description

The TSM108 evaluation board is easily adaptable to a wide range of output power. Several options are available on the board for the power semiconductor packages. Figure 4 shows the electrical connections of all the components available on the Evaluation Board printed circuit board.

Figure 6 : Evaluation Board complete schematic

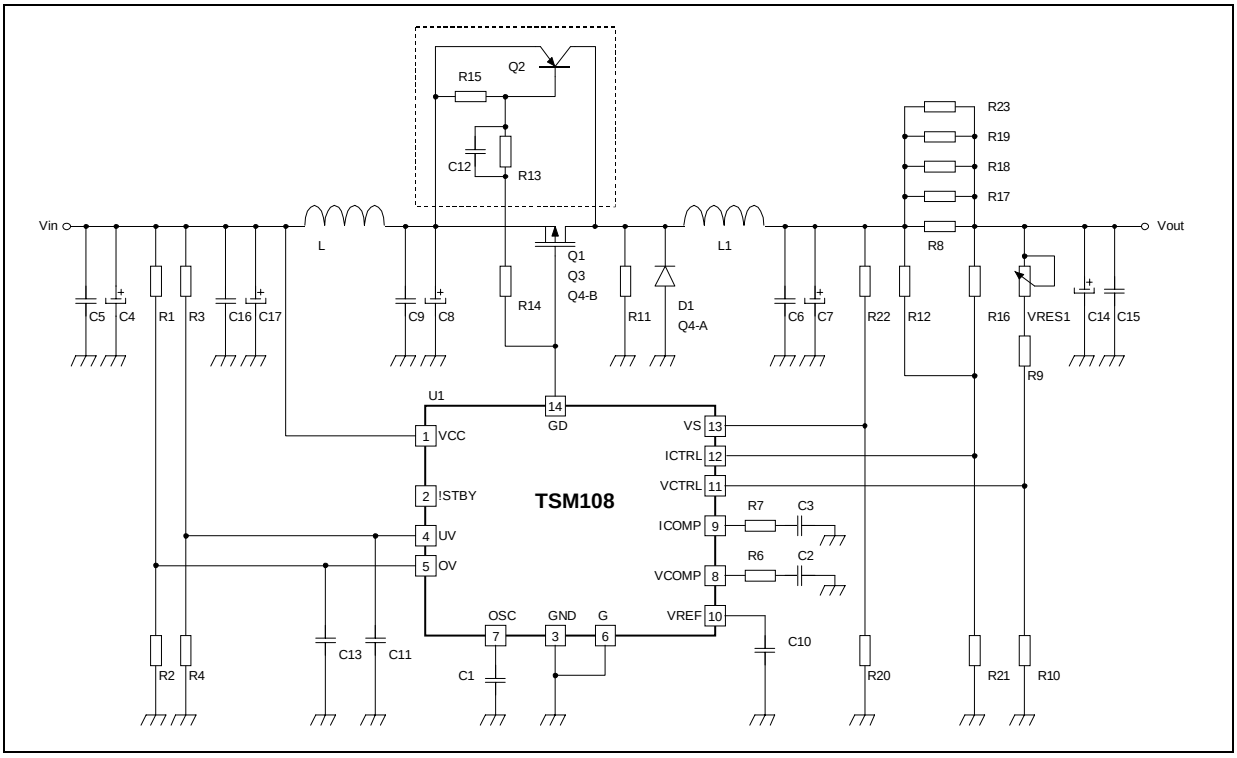
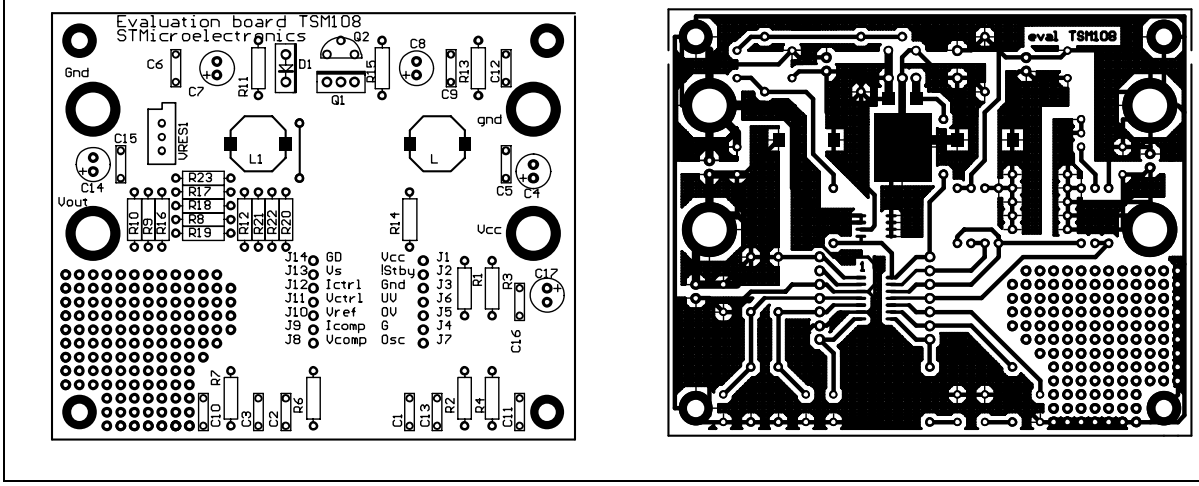
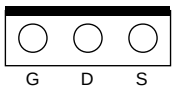
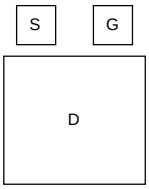
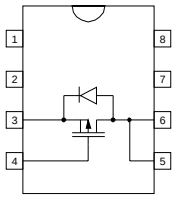
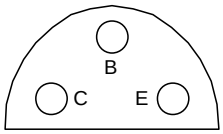
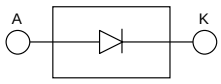
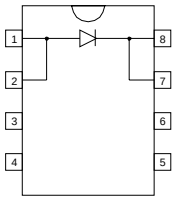


Figure 7 : Evaluation board top layer silk screen and bottom layer overview



The typical application described previously uses a power MOSFET and a schottky diode integrated in the same SO8 package, but several options for power semiconductor footprints are available on the PCB in order to make it adaptable to a wide range of converter output power. The power switch can be replaced by a MOSFET in TO220 or D2PAK package, but also by a bipolar in TO92 package. The diode can be replaced by an axial or TO220 package. The various options available on the Evaluation Board are presented in Table 8 here below.

Table 8 : Power semiconductors options available on the Evaluation Board

Component	Designator	Package	Pinout (topview)
Power Switch (P-Mosfet)	Q1	TO220	
	Q3	D2PAK	
	Q4-B	half SO8	
Power Switch (PNP bipolar)	Q2	TO92	
Power Diode	D1	TO220 or axial	
	Q4-A	half SO8	

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